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**UTILITY  
PATENT APPLICATION  
TRANSMITTAL**

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. 39088/205438

First Inventor or Application Identifier: Wen-Shi Huang et al.

Title of Invention: MAGNETIC BEARING ASSEMBLY

Express Mail Label No. EL 432822763 US

ADDRESS TO: ASSISTANT COMMISSIONER FOR PATENTS  
BOX PATENT APPLICATION  
WASHINGTON, DC 20231

Transmitted herewith for filing in the United States Patent Office is a patent application for:

Inventors: Wen-Shi Huang; Shuh-Chen Chang

1. ☒ The Filing Fee has been calculated as shown below:
2. ☐ Applicant claims Small Entity Status. See 37 CFR 1.27.

	No. Filed	No. Extra	Small Entity Rate	Fee 0	Large Entity Rate	Fee 1
BASIC FEE				\$0		\$710
TOTAL CLAIMS:	15 - 20 =	0	X 9 =	\$0	x 18 =	\$0
INDEP CLAIMS:	2 - 3 =	0	X 40 =	\$0	x 80 =	\$0
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIMS PRESENTED				+135 = \$		+270 = \$
*If the difference in Column 1 is less than zero, enter "0" in Column 2.			TOTAL \$		TOTAL \$ 710	

The Commissioner is hereby authorized to credit overpayments or charge the following fees to Deposit Acct. No. 16-0605.

- a. ☒ Fees required under 37 CFR 1.16 (National filing fees).
- b. ☒ Fees required under 37 CFR 1.17 (National application processing fees).
- ☒ A check in the amount of \$ 710.00 for the filing fee is enclosed.
- ☐ The above filing fee will be paid along with Applicant(s) Response to the Notice to File Missing Parts.
3. ☒ Specification; Total Pages 9
4. ☒ 6 Sheets of Formal Drawing(s) (35 USC 113)
5. ☒ Declaration and Power of Attorney; [Total Pages 2]
- a. ☒ Newly executed (original or copy)
- b. ☐ Copy from a prior application (37 CFR 1.63(d))  
(for continuation/divisional with Box 17 completed)
- i. ☐ DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) & 1.33(b).
6. ☐ Application Data Sheet. See 37 CFR 1.76
7. ☐ CD-ROM or CD-R in duplicate, large table or Computer Program (Appendix)

jc914 U.S. PTO  
09/709794  
11/10/00

8. Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)
- a. ☐ Computer Readable Copy (CRF)
  - b. ☐ Specification Sequence Listing on:
    - i. ☐ CD-ROM or CD-R (2 copies); or
    - ii. ☐ Paper
  - c. ☐ Statement verifying identity of above copies

#### ACCOMPANYING APPLICATION PARTS

9. ☒ Assignment Papers (cover sheet & document(s) (including a check for the \$40.00 fee)
10. ☐ 37 CFR 3.73(b) Statement (when there is an assignee); ☐ Power of Attorney
11. ☐ English Translation Document (if applicable)
12. ☐ Information Disclosure Statement (IDS)/PTO-1449; \_\_\_ Copies of IDS Citations
13. ☒ Preliminary Amendment
14. ☒ Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
15. ☒ Certified Copy of Priority Document(s) (if foreign priority is claimed)
- Foreign Priority is Taiwan, No. 89202989, filed February 24, 2000
16. ☐ Other: \_\_\_
17. **If a CONTINUING APPLICATION**, check appropriate box and supply the requisite information below and in a preliminary amendment, or in an Application Data Sheet under 37 CF 1.76:
- ☐ Continuation ☐ Divisional ☐ Continuation in Part (CIP)
- of prior Application No: \_\_\_; Filed \_\_\_

Prior Application Information: Examiner

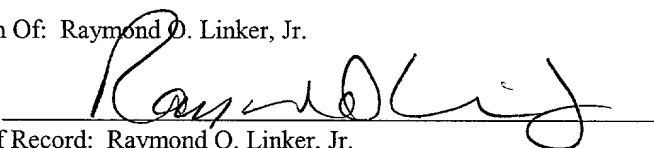
Group/Art Unit:

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 5b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

#### 18. CORRESPONDENCE ADDRESS

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**ALSTON & BIRD LLP**


P.O. Drawer 34009

Charlotte NC 28234-4009

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Date of Deposit November 10, 2000

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Sarah B. Simmons  
CLT01/4451241v1

Attorney's Docket No. 39088/205438

**PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Wen-Shi Huang et al.  
Appl. No.: To be assigned  
Filed: Concurrently herewith  
For: MAGNETIC BEARING ASSEMBLY

November 10, 2000

Assistant Commissioner for Patents  
Washington, DC 20231

**PRELIMINARY AMENDMENT**

Dear Sir:

Please amend the above-identified application as follows:

**In The Claims:**

Claim 15, lines 1 and 2, please delete "The magnetic bearing assembly according to Claim 1,".

**REMARKS**

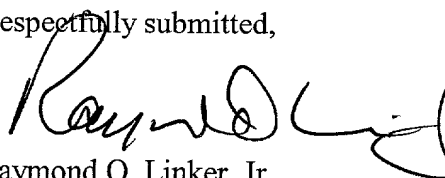
The above amendment is made to more clearly define the invention under United States practice. Please enter this amendment prior to calculation of the filing fee.

It is not believed that extensions of time or fees for net addition of claims are required, beyond those that may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 CFR § 1.136(a), and any fee required

In re: Wen-Shi Huang  
Appl. No.: To be assigned  
Filed: Concurrently herewith  
Page 2

therefore (including fees for net addition of claims) is hereby authorized to be charged to Deposit Account No. 16-0605.

Respectfully submitted,



Raymond O. Linker, Jr.  
Registration No. 26,419

**ALSTON & BIRD LLP**

P.O. Drawer 34009

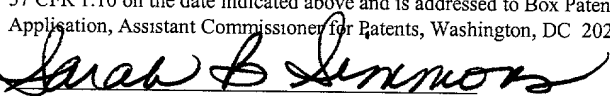
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Date of Deposit: November 10, 2000

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Sarah B. Simmons

**CERTIFICATE OF MAILING**

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CLT01/4451304v1

# MAGNETIC BEARING ASSEMBLY

## FIELD OF THE INVENTION

The present invention relates to a magnetic bearing assembly, and  
5 more particularly to a magnetic bearing assembly capable of generating  
radially and axially repulsive magnetic fields.

## BACKGROUND OF THE INVENTION

A bearing is customarily used to support a rotating shaft of a motor  
when a rotor rotates around the stator circumferentially.

10 There are two general types of bearings: a ball bearing and a self-  
lubricating bearing.

Please refer to Figs. 1(a) and 1(b). The ball bearing includes  
mainly an inner ring 13 which includes a groove as a raceway, an outer  
ring 12 which also includes a groove as a raceway and a plurality of steel  
15 balls 11 which are inserted between respective grooves of the inner and  
outer rings. The inner ring 13 is usually fixed to a rotary shaft 21 of a  
rotor, and the outer ring 12 is fixed to a base or a stator 23. The upper  
side of the ball bearing is urged against a spring 22 for facilitating  
smooth rotation.

20 Upon rotating the shaft, the balls of the ball bearing race around the  
grooves inward the outer ring 12 and outward the inner ring 13. After  
the ball bearing is used for a certain period of time, the fatigue of the  
metal material is customarily found, thereby causing the balls and the  
surface of the inner ring or the outer ring to be abraded.

25 Referring to Figs. 2(a) and 2(b), a self-lubricating bearing  
manufactured of polymeric material is usually in a shape of a sleeve 3  
and it contains minute passages or channels carrying therein the

lubricating oil 31 such that the oil can be deposited on the shaft 21 by diffusion into the inner wall 32 upon rotation of the shaft 21. The inner wall 32 of the self-lubricating bearing usually contacts with a rotary shaft 21, and the outer wall 33 is fixed to a base or a stator 23.

5 In contrast, the ball bearing can perform under heavy loads and has a long life; however, it is costly and has the disadvantage of being abraded. The self-lubricating bearing has good self-lubricating properties to reduce abrasion and is cheaper than the ball bearing; however, it generally incapable of being operated with large loads and its life is not  
10 very long.

It is therefore tried by the present invention to overcome the problems described above.

#### SUMMARY OF THE INVENTION

It is an object of the present invention to provide a magnetic bearing  
15 assembly having an extended lifetime.

It is further an object of the present invention to provide a magnetic bearing assembly having a low cost.

The magnetic bearing assembly according to the present invention comprises a magnetic portion connected to a shaft and a base for  
20 generating a repulsive magnetic field and a bearing portion connected to the shaft and the base for supporting said shaft upon rotation of the shaft.

Certainly, the repulsive magnetic field can be one of a radially repulsive magnetic field and an axial repulsive magnetic field.

Preferably, the bearing portion is a sleeve bearing.

25 Preferably, the base is a stator of a motor.

In an aspect of the present invention, the magnetic portion includes an upper magnetic portion and a lower magnetic portion, wherein the

upper magnetic portion and the lower magnetic portion are disposed symmetrically and each includes a first magnetic ring, a second magnetic ring and a third magnetic ring. The first magnetic ring and the second magnetic ring are connected to the shaft, and the third magnetic ring is  
5 connected to the base. The second magnetic ring and the third magnetic ring are disposed in radial alignment with each other to have like polar disposition. The first magnetic ring and the second magnetic ring are disposed in axial alignment with each other to have opposite polar disposition.

10 In another aspect of the present invention, the magnetic portion includes an upper magnetic portion and a lower magnetic portion, wherein the upper magnetic portion includes an inner magnetic ring and an outer magnetic ring and the lower magnetic portion includes a first magnetic ring, a second magnetic ring and a third magnetic ring. The  
15 inner magnetic ring and the outer magnetic ring are disposed in radial alignment with each other to have like polar disposition. The first magnetic ring and the third magnetic ring are connected to the shaft and the second magnetic ring is connected to the base. The first magnetic ring, the second magnetic ring and the third magnetic ring are disposed  
20 in radial alignment with each other to have opposite polar disposition.

The above objects and advantages of the present invention will become more readily apparent to those ordinarily skilled in the art after reviewing the following detailed description and accompanying drawings, in which:

#### 25 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1(a) is a sectional view of a customarily used ball bearing;

Fig. 1(b) shows a schematic view for an application of a customarily

used ball bearing;

Fig. 2(a) is a sectional view of a customarily used self-lubricating bearing;

Fig. 2(b) shows a schematic view for an application of a customarily  
5 used self-lubricating bearing;

Fig. 3 is a schematic view of the magnetic bearing assembly according to a first embodiment of the present invention; and

Fig. 4 is a schematic view of the magnetic bearing assembly according to a second embodiment of the present invention.

## 10 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 3 is a schematic diagram of the magnetic bearing assembly according to the first embodiment of the present invention. The magnetic bearing assembly includes a magnetic portion and a bearing portion. The bearing portion is a sleeve bearing 5. The magnetic  
15 portion comprises an upper magnetic portion comprising three magnetic rings, i.e. 51, 52 and 53, and a lower magnetic portion comprising three magnetic rings, i.e. 511, 521 and 531. In the upper magnetic portion, the first magnetic ring 51 and the second magnetic ring 52 are connected to the stator 23 and the third magnetic ring 53 is connected to the shaft  
20 21. The second magnetic ring 52 and the third magnetic ring 53 are disposed in radial alignment, wherein these two rings are assembled with each other to have the like polar disposition for generating repulsive magnetic field. In addition, the first magnetic ring 51 and the second magnetic ring 52 are disposed in axial alignment to have opposite polar  
25 disposition for generating an axially repulsive magnetic field. The radially repulsive magnetic field, generated between the second magnetic ring 52 and the third magnetic ring 53, and the axially repulsive



magnetic field, generated between the first magnetic ring 51 and the second magnetic ring 52, allow to reduce friction between the sleeve bearing 5 and the shaft 21 upon rotation of the shaft. The same situation may be deduced by analogy that the three magnetic rings 511,  
5 521 and 531 in the lower magnetic portion facilitate reducing friction between the sleeve bearing 5 and the shaft 21 upon rotation.

Fig. 4 is a schematic diagram of the magnetic bearing assembly according to the second embodiment of the present invention. The magnetic bearing assembly includes a magnetic portion and a bearing portion. The bearing portion is a sleeve bearing 5. The magnetic  
10 portion comprises an upper magnetic portion having two magnetic rings, i.e. an inner magnetic ring 73 and an outer magnetic ring 74, and a lower magnetic portion having three magnetic rings, i.e. 75, 76 and 77. In the upper magnetic portion, the inner magnetic ring 73 is connected to the  
15 shaft 21 and the outer magnetic ring 74 is connected to the stator 23. These two magnetic rings 73 and 74 are disposed in radial alignment with each other to have like polar disposition for generating repulsive magnetic field. In the lower magnetic portion, the first magnetic ring 75 and the third magnetic ring 77 are connected to the shaft 21 and the  
20 second magnetic ring is connected to the stator 23. These three magnetic rings 75, 76 and 77 are disposed in axial alignment to have opposite polar disposition for generating axially repulsive magnetic fields. Therefore, the friction between the sleeve bearing 5 and the shaft 21 upon rotation is considerably reduced.

25 The magnetic bearing assembly according to the present invention provides substantially frictionless rotation. Thus, it requires no lubrication, results in less abrasion and produces low noise, all of which

contribute to extend the operating life of the bearing. Furthermore, the magnetic rings can be made of plastic magnet for reducing the cost of production and the cost of the magnetic bearing assembly is close to the self-lubricating bearing.

- 5        While the foregoing has been described in terms of preferred embodiments of the invention, it will be appreciated by those skilled in the art that many variations and modifications may be made without departing from the principles and spirit of the invention, the scope of which is defined by the appended claims.

10

WHAT IS CLAIMED IS:

1. A magnetic bearing assembly, comprising:
  - a magnetic portion connected to a shaft and a base for generating a repulsive magnetic field; and
  - 5 a bearing portion connected to said shaft and said base for supporting said shaft upon rotation of said shaft.
2. The magnetic bearing assembly according to Claim 1, wherein said repulsive magnetic field is one of a radially repulsive magnetic field and an axial repulsive magnetic field.
- 10 3. The magnetic bearing assembly according to Claim 1, wherein said magnetic portion includes an upper magnetic portion and a lower magnetic portion.
4. The magnetic bearing assembly according to Claim 3, wherein said upper magnetic portion and said lower magnetic portion are disposed
- 15 symmetrically and each includes a first magnetic ring, a second magnetic ring and a third magnetic ring.
5. The magnetic bearing assembly according to Claim 4, wherein said first magnetic ring and said second magnetic ring are connected to said shaft and said third magnetic ring is connected to said base.
- 20 6. The magnetic bearing assembly according to Claim 4, wherein said second magnetic ring and said third magnetic ring are disposed in radial alignment with each other to have like polar disposition.
7. The magnetic bearing assembly according to Claim 4, wherein said first magnetic ring and said second magnetic ring are disposed in axial
- 25 alignment with each other to have opposite polar disposition.
8. The magnetic bearing assembly according to Claim 3, wherein said upper magnetic portion includes an inner magnetic ring and an outer

magnetic ring and said lower magnetic portion includes a first magnetic ring, a second magnetic ring and a third magnetic ring.

9. The magnetic bearing assembly according to Claim 8, wherein said inner magnetic ring and said outer magnetic ring are disposed in radial alignment with each other to have like polar disposition.

10. The magnetic bearing assembly according to Claim 8, wherein said first magnetic ring and said third magnetic ring are connected to the shaft and said second magnetic ring is connected to said base.

11. The magnetic bearing assembly according to Claim 8, wherein said first magnetic ring, said second magnetic ring and said third magnetic ring are disposed in radial alignment with each other to have opposite polar disposition.

12. The magnetic bearing assembly according to Claim 1, wherein said bearing portion is a sleeve bearing.

13. The magnetic bearing assembly according to Claim 1, wherein said base is a stator of a motor.

14. A magnetic bearing assembly, comprising:

a magnetic portion having a plurality of magnetic rings capable of generating therebetween a repulsive magnetic field; and

a bearing portion having a sleeve bearing connected to a shaft and a stator of a motor.

15. The magnetic bearing assembly according to Claim 14, The magnetic bearing assembly according to Claim 1, wherein said repulsive magnetic field is one of a radially repulsive magnetic field and an axial repulsive magnetic field.

Figure 1. The effect of the concentration of the *Agrobacterium* strain on the transformation efficiency of *Agrobacterium* strain 102. The concentration of the *Agrobacterium* strain 102 was varied from 10<sup>2</sup> to 10<sup>8</sup> cells/ml. The transformation efficiency was determined by the number of transformants per 10<sup>5</sup> cells. The data are the mean  $\pm$  SD of three independent experiments.

A magnetic bearing having a magnetic portion for generating a repulsive magnetic field and a bearing portion for supporting a shaft upon its rotation is disclosed. The magnetic bearing assembly according to the present invention provides substantially frictionless rotation. Thus, it requires no lubrication, results in less abrasion and produces low noise, all of which contribute to extend the operating life of the bearing.



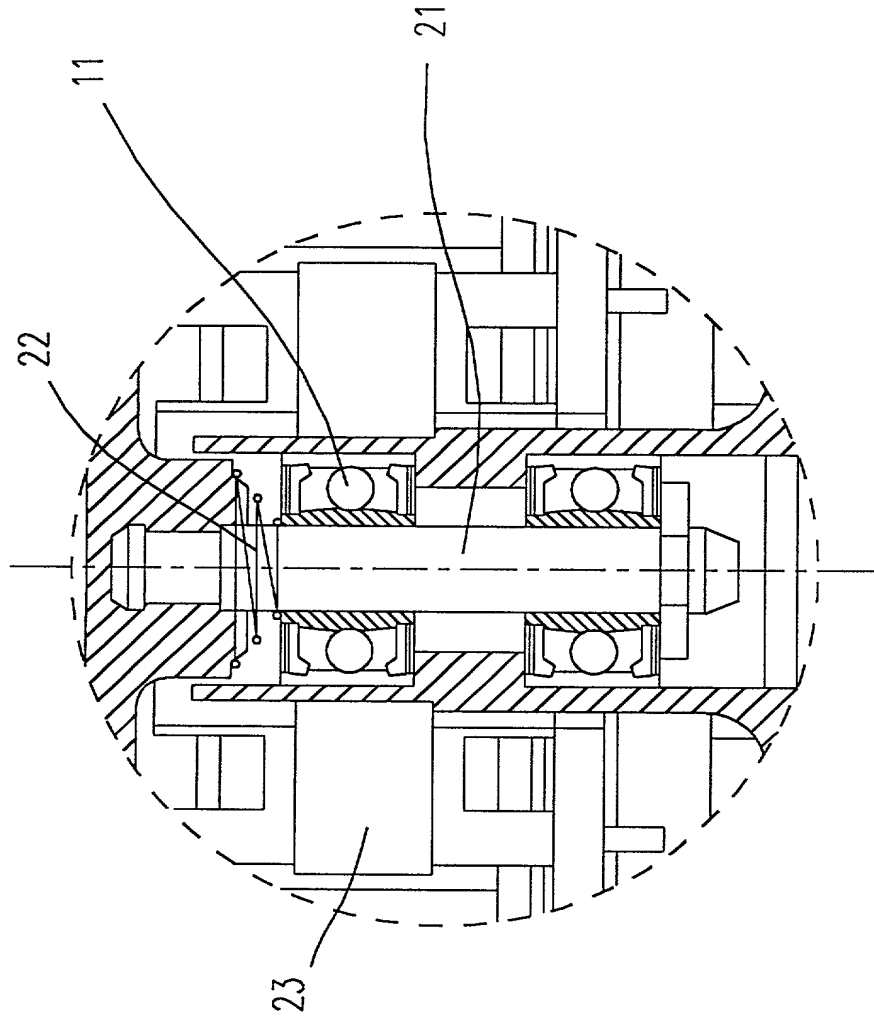


Fig. 1(b)(PRIOR ART)

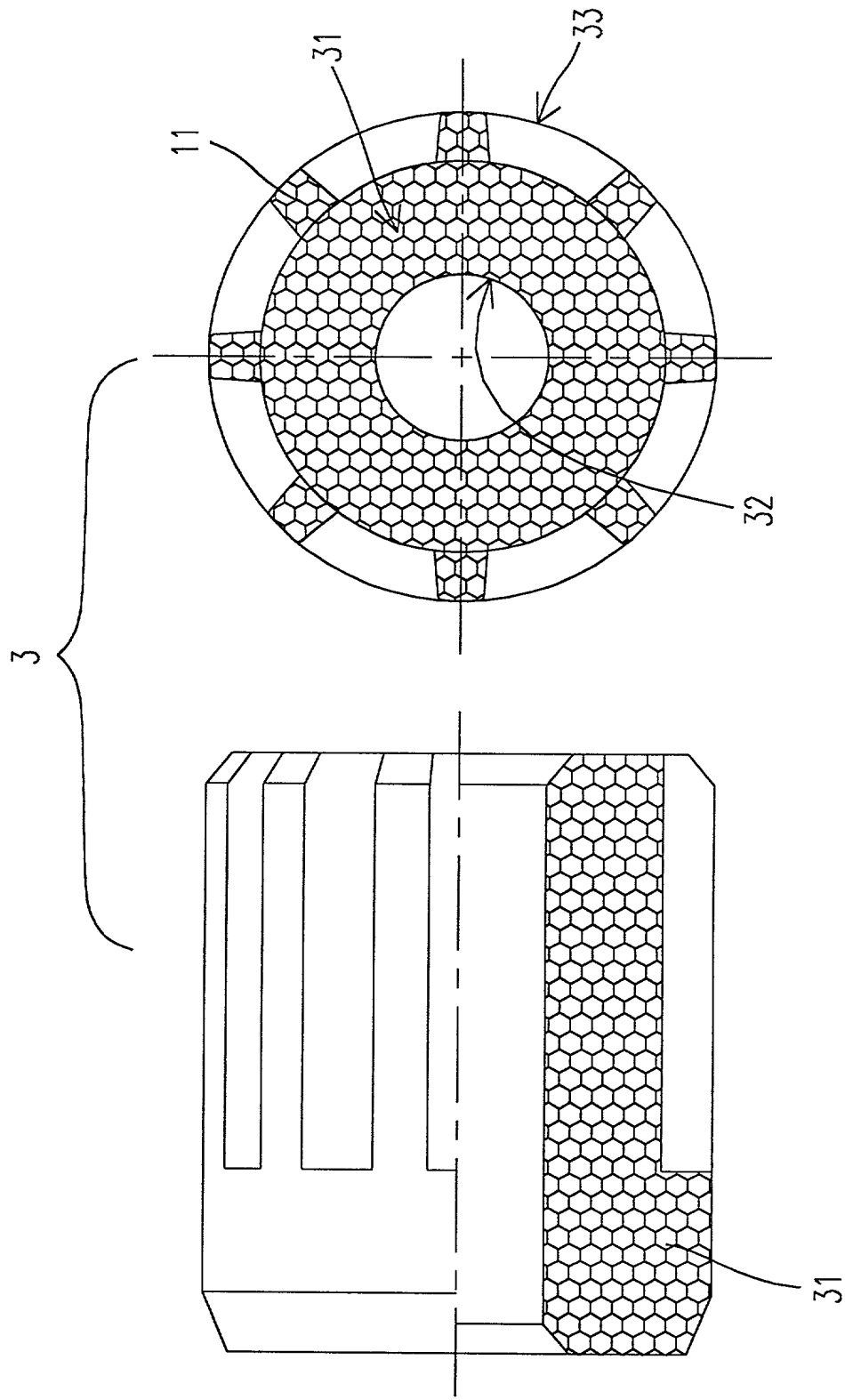


Fig. 2(a)(PRIOR ART)



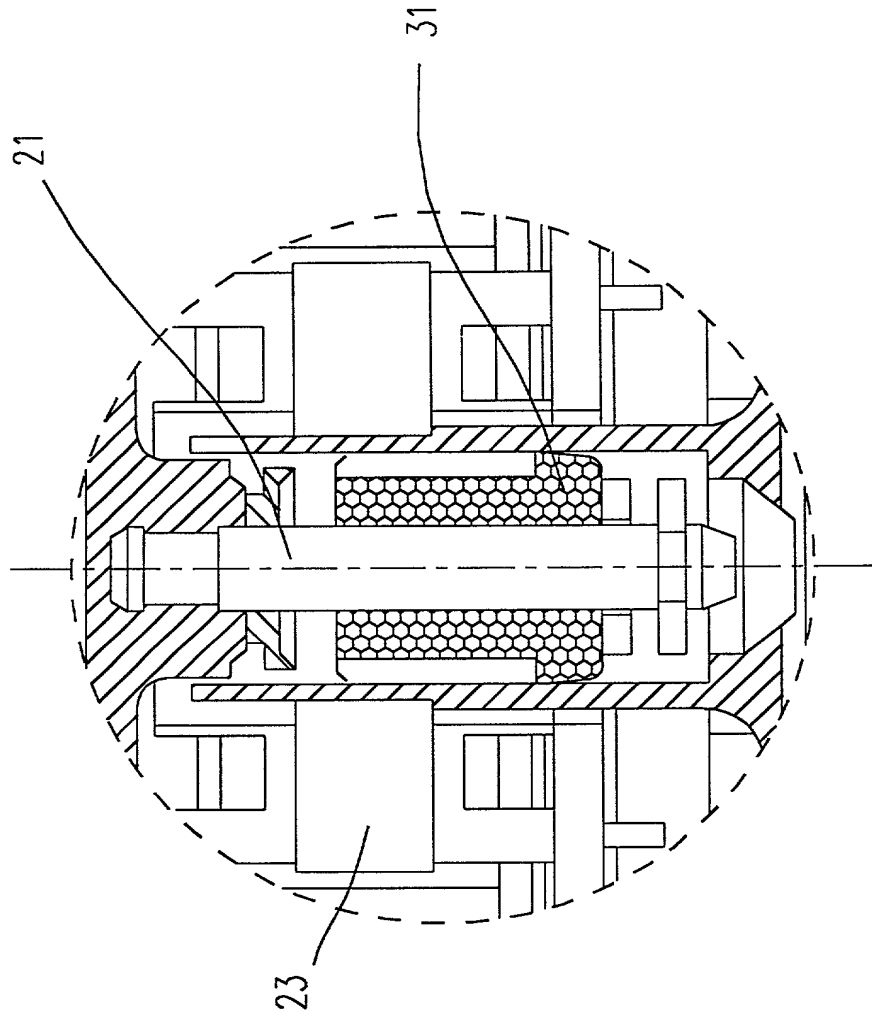


Fig. 2(b)(PRIOR ART)

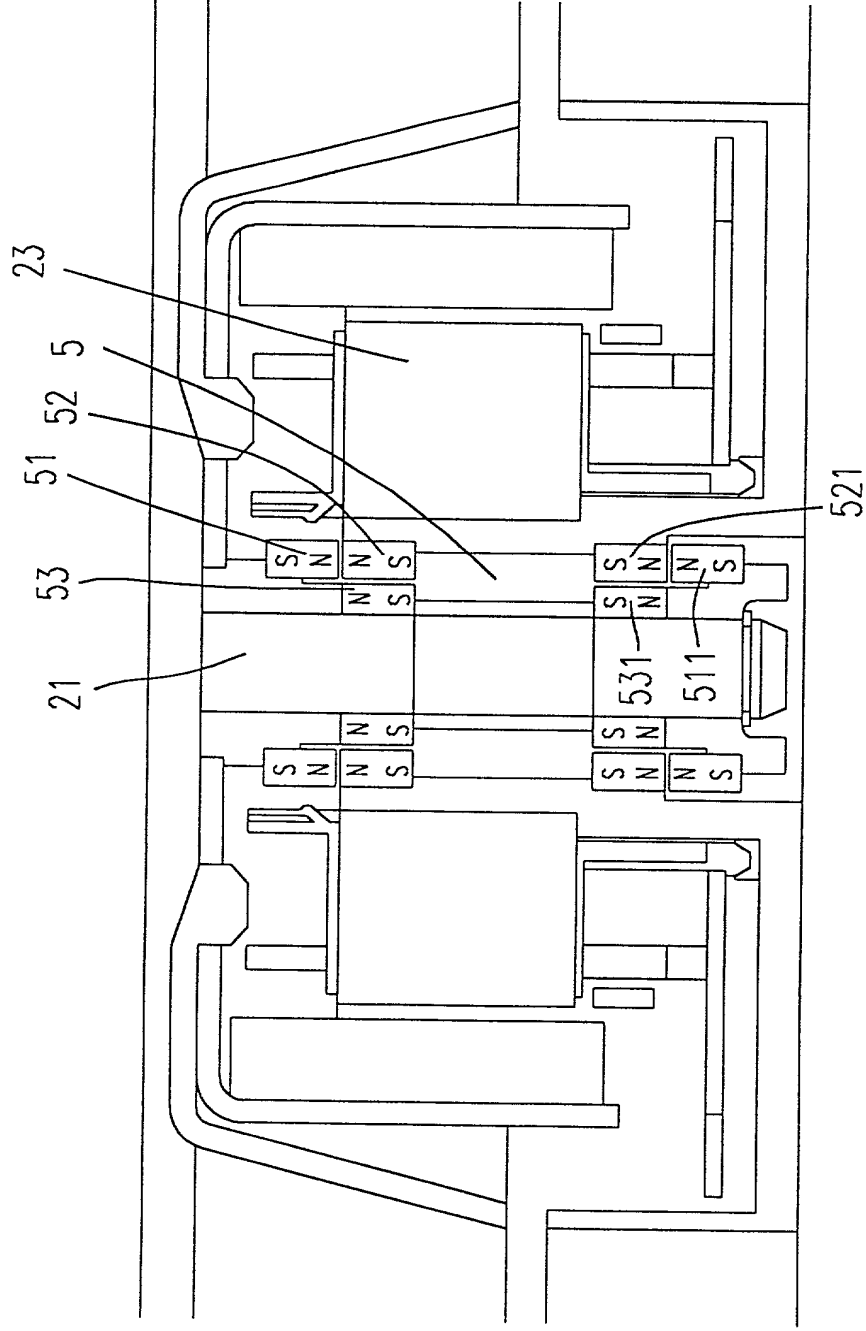


Fig. 3

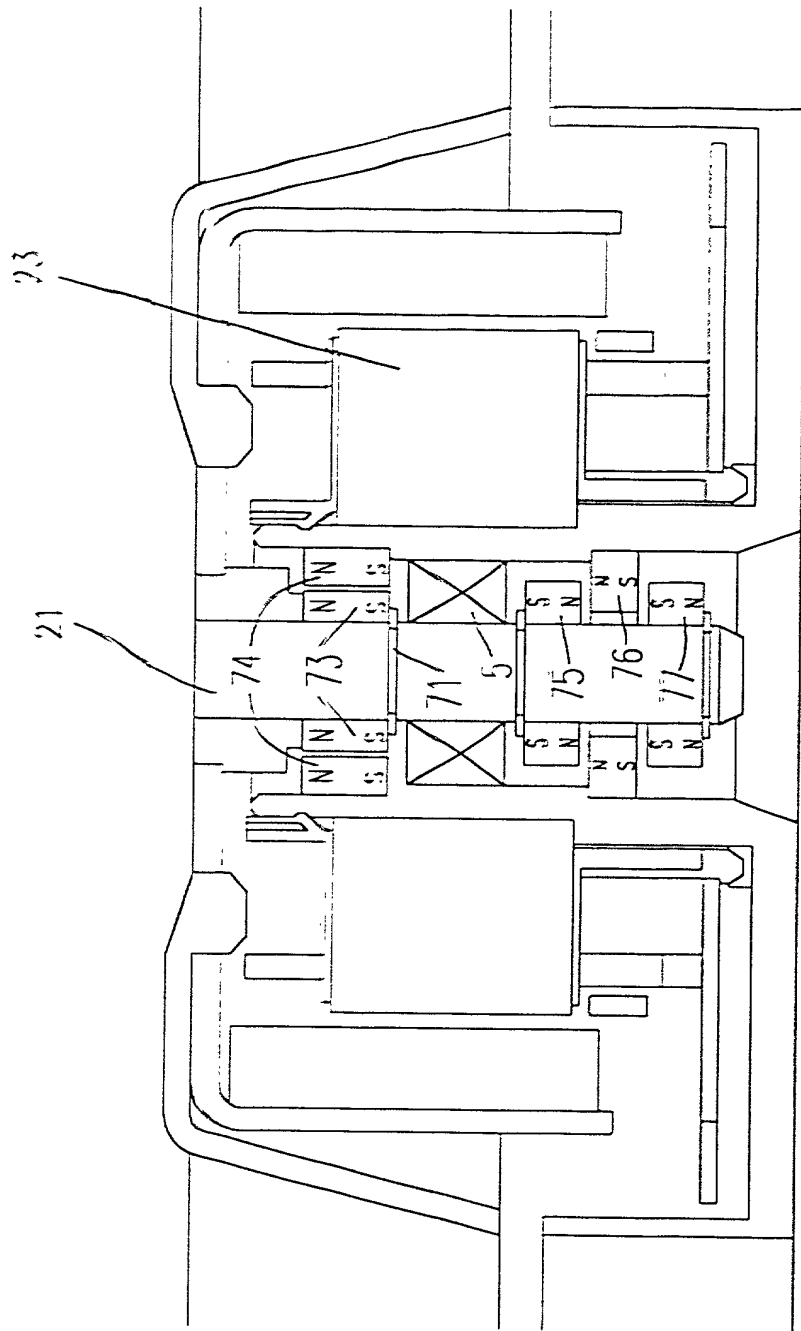


Fig. 4

## Declaration and Power of Attorney For Patent Application English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I verily believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

MAGNETIC BEARING ASSEMBLY

the specification of which

(check one)

☒ is attached hereto.

☐ was filed on \_\_\_\_\_ as  
Application Serial No. \_\_\_\_\_  
and was amended on \_\_\_\_\_  
(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Office all information known to me to be material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

<u>89202989</u>	<u>Taiwan</u>	<u>24/February/2000</u>
(Number)	(Country)	(Day/Month/Year Filed)

_____	_____	_____
(Number)	(Country)	(Day/Month/Year Filed)

_____	_____	_____
(Number)	(Country)	(Day/Month/Year Filed)

Priority Claimed

<input checked="" type="checkbox"/>	<input type="checkbox"/>
Yes	No
<input type="checkbox"/>	<input type="checkbox"/>
Yes	No
<input type="checkbox"/>	<input type="checkbox"/>
Yes	No

I hereby claim the benefit under Title 35, United States Code, § 120 any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of title 35, United States Code, § 112, I acknowledge the duty to disclose to the Office all information known to me to be material to patentability of the application as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)

(Filing Date)

(Status)

(patented, pending, abandoned)

(Application Serial No.)

(Filing Date)

(Status)

(patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

See Attachment

Send Correspondence to Alston & Bird LLP  
1211 East Morehead Street, P.O. Drawer 34009, Charlotte, NC 28234-4009

Direct Telephone Calls to: Alston & Bird LLP  
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Full name of sole or first inventor <b>Wen-Shi Huang</b>	
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Citizenship <b>A citizen of Taiwan, R.O.C.</b>	
Post Office Address <b>The same as above</b>	
Full name of second joint inventor, if any <b>Chang Shun-Chen</b>	
Second Inventor's signature <i>S. C. Chang</i>	Date <b>OCTOBER 18, 2000</b>
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Citizenship <b>A citizen of Taiwan, R.O.C.</b>	
Post Office Address <b>The same as above</b>	

(Supply similar Information and signature for third and subsequent joint inventors.)

## ATTACHMENT

### ATTORNEYS OF ALSTON & BIRD LLP

I hereby appoint the practitioners associated with the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and direct that all correspondence be addressed to that Customer Number:

Customer Number 000826

000826-166060